WHAT IS CLAIMED IS:

1. A current control circuit for a process variable transmitter, the process variable transmitter being coupled to a receiver at a remote location through a two-conductor loop carrying a current signal, and the two-conductor loop providing a signal path and a supply current at a supply voltage for the process variable transmitter, said current control circuit comprising:

(a) an input port having first and second terminals for connecting to respective conductors of the two-conductor loop, and said input port receiving the current signal from the two-conductor loop;

(b) an output port for coupling to a process variable measurement component for measuring a process variable, said output port providing said process variable measurement component with power derived from the current signal in the two-conductor loop, and said process variable measurement component generating an output corresponding to the process variable being measured;

(c) a current controller having a current source for outputting a current signal level in the two-conductor loop, and said current signal level being a function of the state of the process variable output and said current signal level serving to transmit the process variable output to the remote receiver;

(d) an adjustable current controller having an input coupled to said input port for receiving the current signal from the two-conductor loop, and an output coupled to said current source, and said adjustable current controller including a control input for adjusting the level of the current signal received from the two-conductor loop and passed to said current source;

(e) a control component coupled to the control input of said adjustable current controller, said control component being responsive to the supply current being used by the process variable measurement device, and said control component generating a control output for said adjustable current

controller to adjust the received current signal to a level to provide an optimal voltage level for the process variable measurement device.

2. The current control circuit as claimed in claim 1, wherein said adjustable current controller comprises a Junction Field Effect Transistor having a source, drain, and gate, said source providing said input and being coupled to said input port, said drain providing said output and being coupled to said current source, and said gate providing said control input and being responsive to said control output for changing the channel in said Junction Field Effect Transistor and varying the current signal passed to said current source.

3. The current control circuit as claimed in claim 2, wherein said control signal comprises a voltage level applied to said gate, and said voltage level being derived from a sensing circuit, said sensing circuit having a component for sensing the output from said current source.

4. The current control circuit as claimed in claim 1, wherein said adjustable current controller comprises an equivalent circuit for a Junction Field Effect Transistor, said equivalent circuit having a first terminal for said input and being coupled to said current source, a second terminal for said output and being coupled to said current source, and a third terminal for said control input, and said third terminal being coupled to a sensing circuit having a component for sensing the output from said current source and generating a voltage level for said control input to control the current signal to said current source.

5. The current control circuit as claimed in claim 4, wherein said circuit equivalent includes a diode for generating a predetermined drop voltage, said drop voltage having a known temperature variance.

6. The current control circuit as claimed in claim 4, wherein said adjustable current controller comprises first and second BJT transistors, a MOSFET transistor, a Zener diode having an anode and a cathode, a diode having an anode and a cathode, said first and second BJT transistors each having an emitter, a collector, and a base, said MOSFET transistor having a source, drain, and gate, and drain of said MOSFET being connected to the anode of said Zener diode, the cathode of said Zener diode being connected to one terminal of a first resistor and the other terminal of said first resistor being connected to the first terminal of said input port, the gate of said MOSFET transistor being connected to the first terminal of said input port through a second resistor, and the gate of said MOSFET transistor being connected to the collector of said first BJT transistor, the base of said first BJT transistor being connected to the base of said second BJT transistor, and the base and collector of said second BJT transistor being connected together as a diode to compensate the voltage drop and temperature variation of said first BJT transistor, and the base of said second BJT transistor being connected to the source of said MOSFET transistor, and the emitter of said second BJT transistor being connected to a third resistor for sensing current in the loop, and the emitter of said first BJT transistor being connected to the anode of a Light Emitting Diode, said Light Emitting Diode providing a predictable and stable voltage drop in a forward biased state with a bias current.

7. The current control circuit as claimed in claim 6, wherein said Light Emitting Diode has a drop voltage of approximately 1.5 VDC and a bias current less than 1 uA, and further including another resistor connected in series with said LED to provide a total voltage drop of approximately 2.0 VDC.

Claim 8+9
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8. A time of flight ranging system coupled to a receiver at a remote location through a two-conductor loop carrying a current signal, and the

two-conductor loop providing a signal path and a supply current at a supply voltage for the time of flight ranging system to transmit measurements to the remote receiver, said time of flight ranging system comprising:

(a) a process variable measurement stage comprising,

a transducer for emitting energy pulses and coupling reflected energy pulses;

a controller having a receiver stage and a transmitter stage;

said transducer having an input port operatively coupled to said transmitter stage and being responsive to said transmitter stage for emitting said energy pulses, and said transducer including an output port operatively coupled to said receiver component for outputting reflected energy pulses coupled by said transducer;

said receiver stage converting said reflected energy pulses into corresponding electrical signals for output to said controller, and said controller including a program component for processing said electrical signals and generating measurement readings;

(b) a current control circuit comprising,

an input port having first and second terminals for connecting to respective conductors of the two-conductor loop, and said input port receiving the current signal from the two-conductor loop;

an output port for coupling to a process variable measurement component for measuring a process variable, said output port providing said process variable measurement component with a power supply derived from the current signal in the two-conductor loop, and said process variable measurement component generating an output corresponding to the process variable being measured;

a current controller having a current source for outputting a current signal level in the two-conductor loop, and said current signal level being a function of the state of the process variable output and

said current signal level serving to transmit the process variable output to the remote receiver;

an adjustable current controller having an input coupled to said input port for receiving the current signal from the two-conductor loop, and an output coupled to said current source, and said adjustable current controller including a control input for adjusting the level of the current signal received from the two-conductor loop and passed to said current source;

a control component coupled to the control input of said adjustable current controller, said control component being responsive to the supply current being used by the process variable measurement device, and said control component generating a control output for said adjustable current controller to adjust the received current signal to a level to provide an optimal voltage level for the process variable measurement device.

9. The time of flight ranging system as claimed in claim 8, further including a reservoir capacitor coupled to said input port for receiving current at the supply voltage from said two-conductor loop and storing energy as a function of the received current and the supply voltage level.

10. A pulse-echo acoustic ranging system coupled to a receiver at a remote location through a two-conductor loop carrying a current signal, and the two-conductor loop providing a signal path and a supply current at a supply voltage for the pulse-echo acoustic ranging system to transmit measurements to the remote receiver, said pulse echo acoustic ranging system comprising:

(a) a process variable measurement stage comprising,

a transducer for emitting acoustic pulses and coupling reflected acoustic pulses;

a controller having a receiver stage and a transmitter stage; said transducer having an input port operatively coupled to said transmitter stage and being responsive to said transmitter stage for emitting said acoustic pulses, and said transducer including an output port operatively coupled to said receiver component for outputting reflected acoustic pulses coupled by said transducer; said receiver stage converting said reflected acoustic pulses into corresponding electrical signals for output to said controller, and said controller including a program component for processing said electrical signals and generating measurement readings;

(b) a current control circuit comprising,

an input port having first and second terminals for connecting to respective conductors of the two-conductor loop, and said input port receiving the current signal from the two-conductor loop; an output port for coupling to a process variable measurement component for measuring a process variable, said output port providing said process variable measurement component with a power supply derived from the current signal in the two-conductor loop, and said process variable measurement component generating an output corresponding to the process variable being measured;

a current controller having a current source for outputting a current signal level in the two-conductor loop, and said current signal level being a function of the state of the process variable output and said current signal level serving to transmit the process variable output to the remote receiver; an adjustable current controller having an input coupled to said input port for receiving the current signal from the two-conductor loop, and an output coupled to said current source, and said adjustable current controller including a control input for adjusting the level of the current signal received from the two-conductor loop and passed to said current source; a control component coupled to the

control input of said adjustable current controller, said control component being responsive to the supply current being used by the process variable measurement device, and said control component generating a control output for said adjustable current controller to adjust the received current signal to a level to provide an optimal voltage level for the process variable measurement device.

11. The pulse-echo acoustic ranging system as claimed in claim 10, further including a reservoir capacitor coupled to said input port for receiving current at the supply voltage from said two-conductor loop and storing energy as a function of the received current and the supply voltage level.

12. The current control circuit as claimed in claim 11, wherein said adjustable current controller comprises a Junction Field Effect Transistor having a source, drain, and gate, said source providing said input and being coupled to said input port, said drain providing said output and being coupled to said current source, and said gate providing said control input and being responsive to said control output for changing the channel in said Junction Field Effect Transistor and varying the current signal passed to said current source.

13. The current control circuit as claimed in claim 12, wherein said control signal comprises a voltage level applied to said gate, and said voltage level being derived from a sensing circuit, said sensing circuit having a component for sensing the output from said current source.

14. The current control circuit as claimed in claim 11, wherein said adjustable current controller comprises an equivalent circuit for a Junction Field Effect Transistor, said equivalent circuit having a first terminal for said input and being coupled to said current source, a second terminal for said

output and being coupled to said current source, and a third terminal for said control input, and said third terminal being coupled to a sensing circuit having a component for sensing the output from said current source and generating a voltage level for said control input to control the current signal to said current source.

15. The current control circuit as claimed in claim 14, wherein said equivalent circuit includes a diode for generating a predetermined and stable drop voltage, said drop voltage having a known temperature variance characteristic.

16. The current control circuit as claimed in claim 11, wherein said adjustable current controller comprises first and second BJT transistors, a MOSFET transistor, a Zener diode having an anode and a cathode, a diode having an anode and a cathode, said first and second BJT transistors each having an emitter, a collector, and a base, said MOSFET transistor having a source, drain, and gate, and drain of said MOSFET being connected to the anode of said Zener diode, the cathode of said Zener diode being connected to one terminal of a first resistor and the other terminal of said first resistor being connected to the first terminal of said input port, the gate of said MOSFET transistor being connected to the first terminal of said input port through a second resistor, and the gate of said MOSFET transistor being connected to the collector of said first BJT transistor, the base of said first BJT transistor being connected to the base of said second BJT transistor, and the base and collector of said second BJT transistor being connected together as a diode to compensate the voltage drop and temperature variation of said first BJT transistor, and the base of said second BJT transistor being connected to the source of said MOSFET transistor, and the emitter of said second BJT transistor being connected to a third resistor for sensing current in the loop, and the emitter of said first BJT transistor being connected to the anode of a

Light Emitting Diode, said Light Emitting Diode providing a predictable and stable voltage drop in a forward biased state with a bias current.

17. The current control circuit as claimed in claim 16, wherein said Light Emitting Diode has a drop voltage of approximately 1.5 VDC and a bias current less than 1 uA, and further including another resistor connected in series with said LED to provide a total voltage drop of approximately 2.0 VDC.